Chapter 4
Operation and Maintenance Manuals

4-1. General

An adequate operation and maintenance manual must be prepared to permit successful operation of the pumping station. The portion of the manual covering the mechanical and electrical equipment is generally prepared by the designers responsible for specifying this equipment. The manual should provide a platform for carry-over of information from the designer to the operating personnel. The manual should be prepared to aid the operating personnel in understanding the equipment and to set the guidelines for maintenance procedures. A manual provides a guide which can carry on beyond personnel changes and verbal instructions.

4-2. Coverage

a. General. The operation and maintenance manual should be complete. In most instances, this manual will be the only information available to operate and maintain the station. The contents are usually divided into three sections, operation, maintenance, and reference. Each section is described below, and some examples are included in Appendix F. General guidelines are included in ER 25-345-1, Systems Operation and Maintenance Documentation. Although ER 25-345-1 is for military construction, it also contains valuable information that pertains to civil works projects. The electrical fault protection coordination study, including protective device settings, should be provided with the operation and maintenance manual.

b. Operation. The operation portion is divided into three parts: criteria, constraints, and procedures. The criteria portion describes the operation of the facility that satisfies the project requirements. It deals with the overall operation of the station as opposed to operation of individual pieces of equipment. The constraints section should indicate all conditions that must be considered external to the station so that it can be successfully operated. These items usually consist of control structures away from the station that require certain gate opening and closing operations for the station to perform properly. The procedures part would include detailed operating procedures for each piece of equipment. The detailed equipment operating procedures are provided by the equipment manufacturers. The operations portion of the operation and maintenance manual should be coordinated with the hydraulics and hydrology (H&H) engineers.

c. Maintenance.

(1) General. A pumping station maintenance program should consist of inspections, standards, a control system, and lubrication. The available shop drawings on the equipment should be made a part of the manual so that they may be used when performing detailed maintenance or repair work.

(2) Inspections. The success of a maintenance program is dependent on adequate inspections. The inspections assure that the equipment receives proper attention and is ready for use. The extent of preventative maintenance inspections includes adjusting, lubricating, repairing, and replacing worn out or defective parts. A guide for the inspection frequencies and tasks for the various items of equipment is usually obtained from manufacturers' recommendations, but may need to be adjusted for flood control pumping station operating conditions. Any changes to manufacturers' recommendations should be coordinated with the manufacturer to avoid the possibility of voiding warranties.

(3) Standards. A balanced criteria maintenance program must be based on defined criteria that establish quality, extent, and quantity of maintenance desired. A quality program requires capable personnel, proper tools, use of quality materials, and a record of meeting program performance. The maintenance recommendations of most equipment manufacturers are usually for continuous operation, which is typically not the case for flood control pumping stations. Inspection and maintenance requirements must be keyed to the expected operation of the station.

(4) Control system. An effective maintenance control system should include comprehensive and accurate basic data, such as equipment records, historical inspection, maintenance, and repair records. Effective scheduling of maintenance work is required to ensure the most effective use of the operating agencies' personnel. The record filing system should consist of:

(a) An equipment data file. This file should be indexed by equipment name or title and contain all pertinent data for that specific item of equipment or facility, such as manufacturers' instruction books, operating pressure limits, parts catalogs, manufacturers' drawings, reference field tests, special reports on major repairs, dates of replacements and retirements, and changes in operating procedures.

(b) A preventative maintenance file. This file should contain a record of equipment inspections, maintenance data, a record of hours of operation, number of operations, or other significant operating data. Consideration should be given to furnishing the information on a computer database program for large and complex stations.

(5) Lubrication. Proper lubrication is an important part of a good maintenance program. Dependable operation and the life expectancy of equipment requiring lubrication are almost entirely dependent on the use of proper lubricants at the right time intervals and in the proper quantities. All equipment requiring lubrication should be surveyed and appraised for the type of bearings, gears, and service conditions under which the equipment must operate. After these operating conditions are fully analyzed, then it can be determined what characteristics the proper lubricant should have, such as resistance to moisture, temperature range, whether an extreme pressure lubricant is required, and the proper viscosity range. Some manufacturers recommend only the viscosity of the lubricant while others list the lubricants by trade name. The number of different types should be kept to a minimum. The frequency of lubrication used is recommended by the manufacturer. The frequency of lubrication may have to be adjusted based on special use or experience. The equipment must be examined in detail when preparing lubrication instructions, so that every grease fitting and oiling location can be indicated in the maintenance instructions. Manufacturers' information does not always show enough detail to permit accurate preparation of the lubrication instructions. Photographs of the various pieces of equipment showing the locations of all the lubricating points are very useful.

d. Reference. The reference section of the operation and maintenance manual should contain a listing of all data that are necessary to operate and maintain the station. These data should include all of the shop drawings for the equipment, as-built contract drawings, advertised specifications, and design memoranda used in the design of the station. Copies of all reference items except the design memoranda should be furnished to the user as an appendix to the operation and maintenance manual. The design memoranda should be furnished as a separate package. The contract specifications for the equipment should contain the requirement for the contractor to furnish as-built shop drawings of the equipment. Since this reference material is usually voluminous, it is recommended that a file cabinet be furnished as part of the construction of the station so that adequate storage is available at the station.

4-3. Schedule

The construction of a pumping station usually does not permit a final manual to be prepared before it is turned over to the user or operating agency. Because of this, an interim manual should be prepared to benefit the end user when they receive the station. The interim manual should include complete operating instructions and any maintenance instructions prepared to that time. The operating instructions should be prepared early enough so that they may be checked during the preliminary and final testing of the station. The final operation and maintenance manual should be available for the user within 1 year of the turnover date of the pumping station.

4-4. Testing and Exercise

Since flood control pumping stations are usually operated on an infrequent basis, trial operation is required between flood events. All equipment should be operated at least every 30 days. It is acceptable to operate the pumping equipment in the dry providing that equipment is designed for dry operation and the water level present is below the bottom of the pump suction bell or umbrella. Wet testing of pumping equipment should occur only if the water present is above the minimum pumping level. These test operations should be included in the maintenance schedule. The duration of the exercise period should be coordinated with the equipment suppliers but should be limited to as short a period as possible.